Claims

1. A composition comprising isolated PSMA protein, wherein at least 5% of the isolated PSMA protein is an isolated PSMA protein multimer.

2. The composition of claim 1, wherein the isolated PSMA protein multimer is an isolated PSMA protein dimer.

3. The composition of claim 2, wherein the isolated PSMA protein dimer comprises a fragment of full-length PSMA (SEQ ID NO: 1).

4. The composition of claim 2, wherein the isolated PSMA protein dimer comprises a fragment of the extracellular portion of PSMA (amino acids 44-750 of SEQ ID NO: 1).

5. The composition of claim 3, wherein the fragment comprises amino acids 58-750 of SEQ ID NO: 1.

6. The composition of claim 3, wherein the fragment comprises amino acids 44-750 of SEQ ID NO: 1.

7. The composition of claim 3, wherein the fragment comprises amino acids 601-750 of SEQ ID NO: 1.

8. The composition of claim 2, wherein at least 25% of the isolated PSMA protein is in the form of an isolated PSMA protein dimer.

9. The composition of claim 2, wherein at least 50% of the isolated PSMA protein is in the form of an isolated PSMA protein dimer.

10. The composition of claim 2, wherein at least 75% of the isolated PSMA protein is in the form of an isolated PSMA protein dimer.

11. The composition of claim 2, wherein at least 90% of the isolated PSMA protein is in the form of an isolated PSMA protein dimer.

12. The composition of claim 2, wherein at least 95% of the isolated PSMA protein is in the form of an isolated PSMA protein dimer.

13. The composition of any one of claims 1-12, wherein the composition further comprises at least 0.25 molar equivalents of metal ion to PSMA protein.

14. The composition of claim 13, wherein the composition comprises at least 0.5 molar equivalents of metal ion to PSMA protein.

15. The composition of claim 13, wherein the composition comprises at least 1 molar equivalent of metal ion to PSMA protein.

16. The composition of claim 13, wherein the composition comprises a molar excess of metal ion to PSMA protein.

17. The composition of any one of claims 1-16, wherein the composition is in a liquid or lyophilized form.

18. The composition of any one of claims 1-17, wherein the composition further comprises an adjuvant.

19. The composition of claim 18, wherein the adjuvant is alum, monophosphoryl lipid A, a saponin, an immunostimulatory oligonucleotide, incomplete Freund's adjuvant, complete Freund's adjuvant, montanide, vitamin E, a water-in-oil emulsions prepared from a biodegradable oil, Quil A, a MPL and mycobacterial cell wall skeleton combination, ENHANZYN™, CRL-1005, L-121, alpha-galactosylceramide or a combination thereof.

20. The composition of claim 19, wherein the adjuvant is alum.

21. The composition of any one of claims 1-18, wherein the composition further comprises a cytokine.

22. The composition of any one of claims 1-18 and 21, wherein the composition is sterile.

23. The composition of any one of claims 1-18 and 21, wherein the composition is free of chelating agents.

24. The composition of any one of claims 1-18 and 21, wherein the composition further comprises at least one buffer.

25. The composition of claim 24, wherein the at least one buffer is PBS (phosphate buffered saline), citric acid, sodium citrate, sodium acetate, acetic acid, sodium phosphate, phosphoric acid, sodium ascorbate, tartartic acid, maleic acid, glycine, sodium lactate, lactic acid, ascorbic acid, imidazole, sodium bicarbonate, carbonic acid, sodium succinate, succinic acid, histidine, sodium benzoate, benzoic acid or a combination thereof.

26. The composition of any one of claims 1-18 and 21, wherein the composition further comprises a free amino acid, wherein the free amino acid is naturally occurring or non-naturally occurring.

27. The composition of claim 26, wherein the naturally occurring or non-naturally occurring free amino acid is a non-acidic free amino acid.

28. The composition of claim 27, wherein the non-acidic free amino acid is glycine, proline, isoleucine, leucine, alanine, arginine or a combination thereof.

29. The composition of any one of claims 1-18 and 21, wherein the composition further comprises a surfactant.

30. The composition of claim 29, wherein the surfactant is Tween20, Tween80, Triton X-100, dodecylmaltoside, cholic acid, CHAPS or a combination thereof.

31. The composition of any one of claims 1-18 and 21, wherein the composition further comprises a cryoprotectant, an antioxidant, a preservative or a combination thereof.

32. The composition of claim 31, wherein the cryoprotectant is a sugar, a polyol, an amino acid, a polymer, an inorganic salt, an organic salt, trimethylamine N-oxide, sarcosine, betaine, gamma-aminobutyric acid, octapine, alanopine, strombine, dimethylsulfoxide or ethanol.

33. The composition of claim 32, wherein the sugar is sucrose, lactose, glucose, trehalose or maltose.

34. The composition of claim 32, wherein the polyol is inositol, ethylene glycol, glycerol, sorbitol, xylitol, mannitol or 2-methyl-2,4-pentane-diol.

35. The composition of claim 32, wherein the amino acid is Na glutamate, proline, alpha-alanine, beta-alanine, glycine, lysine-HCl or 4-hydroxyproline.

36. The composition of claim 32, wherein the polymer is polyethylene glycol, dextran or polyvinylpyrrolidone.

37. The composition of claim 32, wherein the inorganic salt is sodium sulfate, ammonium sulfate, potassium phosphate, magnesium sulfate or sodium fluoride.

38. The composition of claim 32, wherein the organic salt is sodium acetate, sodium polyethylene, sodium caprylate, proprionate, lactate or succinate.

39. The composition of claim 31, where the antioxidant is ascorbic acid, an ascorbic acid derivative, butylated hydroxy anisole, butylated hydroxy toluene, alkylgallate, dithiothreitol (DTT), sodium meta-bisulfite, sodium bisulfite, sodium dithionite, sodium

thioglycollic acid, sodium formaldehyde sulfoxylate, tocopherol, a tocopherol derivative, monothioglycerol or sodium sulfite.

40. The composition of claim 39, wherein the ascorbic acid derivative is ascorbylpalmitate, ascorbylstearate, sodium ascorbate or calcium ascorbate.

41. The composition of claim 39, wherein the tocopherol derivative is d-alpha tocopherol, d-alpha tocopherol acetate, dl-alpha tocopherol acetate, d-alpha tocopherol succinate, beta tocopherol, delta tocopherol, gamma tocopherol or d-alpha tocopherol polyoxyethylene glycol 1000 succinate.

42. The composition of claim 31, wherein the preservative is benzalkonium chloride, chlorobutanol, parabens, thimerosal, benzyl alcohol or phenol.

43. A composition comprising isolated multimeric PSMA protein, wherein the composition comprises less than 35% of a monomeric PSMA protein.

44. The composition of claim 43, wherein the isolated multimeric PSMA protein is an isolated dimeric PSMA protein.

45. The composition of claim 43 or 44, wherein the composition comprises less than 20% of the monomeric PSMA protein.

46. The composition of claim 45, wherein the composition comprises less than 15% of the monomeric PSMA protein.

47. The composition of claim 46, wherein the composition comprises less than 5% of the monomeric PSMA protein.

48. A composition comprising PSMA protein in a solution that promotes or preserves multimeric association of PSMA protein.

49. The composition of claim 48, wherein the solution that promotes or preserves multimeric association of PSMA protein is a solution that promotes or preserves dimeric association of PSMA protein.

50. The composition of claim 48 or 49, wherein the solution that promotes or preserves dimeric association of PSMA protein has a pH that ranges from 4 to 8.

51. The composition of claim 50, wherein the solution that promotes or preserves dimeric association of PSMA protein has a pH that ranges from 5 to 7.

52. The composition of claim 51, wherein the solution that promotes or preserves dimeric association of PSMA protein has a pH that ranges from 5.5 to 7.

53. The composition of claim 51, wherein the solution that promotes or preserves dimeric association of PSMA protein has a pH of 6.

54. The composition of any one of claims 48-53, wherein the solution that promotes or preserves dimeric association of PSMA protein comprises a salt.

55. The composition of claim 54, wherein the cationic component of the salt is sodium, potassium, ammonium, magnesium, calcium, zinc or a combination thereof, and wherein the anionic component of the salt is chloride, sulfate, acetate or a combination thereof.

56. The composition of claim 55, wherein the salt is sodium chloride, sodium sulfate, sodium acetate or ammonium sulfate.

57. The composition of claim 56, wherein the salt is present at a concentration in the range of 50mM to 2M.

58. The composition of claim 57, wherein the salt is present at a concentration in the range of 100mM to 300mM.

59. The composition of claim 58, wherein the salt is present at a concentration of 150mM.

60. The composition of claim 57, wherein the composition further comprises an adjuvant.

61. The composition of claim 57, wherein the composition is physiologically acceptable.

62. The composition of any one of claims 48-61, wherein the solution that promotes or preserves dimeric association of PSMA protein comprises metal ions.

63. The composition of claim 62, wherein the metal ions are zinc ions, calcium ions, magnesium ions, cobalt ions, manganese ions or a combination thereof.

64. The composition of claim 63, wherein the metal ions are zinc ions and calcium ions.

65. The composition of claim 64, wherein the zinc ions and calcium ions are present at a concentration in the range of 0.1mM to 5mM.

66. The composition of claim 64, wherein the zinc ions are present at a concentration that is lower than the concentration of the calcium ions.

67. The composition of claim 66, wherein the zinc ions are present at a concentration of 0.1mM and the calcium ions are present at a concentration of 1mM.

68. The composition of claim 63, wherein the metal ions are magnesium ions.

69. The composition of claim 68, wherein the magnesium ions are present at a concentration in the range of 0.1mM to 5mM.

70. The composition of claim 69, wherein the magnesium ions are present at a concentration of 0.5mM.

71. The composition of any one of claims 48-70, wherein the solution that promotes or preserves dimeric association of PSMA protein is free of chelating agents.

72. The composition of any one of claims 48-70, wherein the composition further comprises at least one buffer.

73. The composition of claim 72, wherein the at least one buffer is PBS (phosphate buffered saline), citric acid, sodium citrate, sodium acetate, acetic acid, sodium phosphate, phosphoric acid, sodium ascorbate, tartartic acid, maleic acid, glycine, sodium lactate, lactic acid, ascorbic acid, imidazole, sodium bicarbonate, carbonic acid, sodium succinate, succinic acid, histidine, sodium benzoate, benzoic acid or a combination thereof.

74. The composition of claim 48-70, wherein the composition further comprises a free amino acid, wherein the free amino acid is naturally occurring or non-naturally occurring.

75. The composition of claim 74, wherein the naturally occurring or non-naturally occurring free amino acid is a non-acidic free amino acid.

76. The composition of claim 75, wherein the non-acidic free amino acid is glycine, proline, isoleucine, leucine, alanine, arginine or a combination thereof.

77. The composition of claim 48-70, wherein the composition further comprises a surfactant.

78. The composition of claim 77, wherein the surfactant is Tween20, Tween80, Triton X-100, dodecylmaltoside, cholic acid, CHAPS or a combination thereof.

79. The composition of claim 48-70, wherein the composition further comprises a cryoprotectant, an antioxidant, a preservative or a combination thereof.

80. The composition of claim 79, wherein the cryoprotectant is a sugar, a polyol, an amino acid, a polymer, an inorganic salt, an organic salt, trimethylamine N-oxide, sarcosine, betaine, gamma-aminobutyric acid, octapine, alanopine, strombine, dimethylsulfoxide or ethanol.

81. The composition of claim 80, wherein the sugar is sucrose, lactose, glucose, trehalose or maltose.

82. The composition of claim 80, wherein the polyol is inositol, ethylene glycol, glycerol, sorbitol, xylitol, mannitol or 2-methyl-2,4-pentane-diol.

83. The composition of claim 80, wherein the amino acid is Na glutamate, proline, alpha-alanine, beta-alanine, glycine, lysine-HCl or 4-hydroxyproline.

84. The composition of claim 80, wherein the polymer is polyethylene glycol, dextran or polyvinylpyrrolidone.

85. The composition of claim 80, wherein the inorganic salt is sodium sulfate, ammonium sulfate, potassium phosphate, magnesium sulfate or sodium fluoride.

86. The composition of claim 80, wherein the organic salt is sodium acetate, sodium polyethylene, sodium caprylate, proprionate, lactate or succinate.

87. The composition of claim 79, where the antioxidant is ascorbic acid, an ascorbic acid derivative, butylated hydroxy anisole, butylated hydroxy toluene, alkylgallate, dithiothreitol (DTT), sodium meta-bisulfite, sodium bisulfite, sodium dithionite, sodium thioglycollic acid, sodium formaldehyde sulfoxylate, tocopherol, a tocopherol derivative, monothioglycerol or sodium sulfite.

88. The composition of claim 87, wherein the ascorbic acid derivative is ascorbylpalmitate, ascorbylstearate, sodium ascorbate or calcium ascorbate.

89. The composition of claim 87, wherein the tocopherol derivative is d-alpha tocopherol, d-alpha tocopherol acetate, dl-alpha tocopherol acetate, d-alpha tocopherol succinate, beta tocopherol, delta tocopherol, gamma tocopherol or d-alpha tocopherol polyoxyethylene glycol 1000 succinate.

90. The composition of claim 79, wherein the preservative is benzalkonium chloride, chlorobutanol, parabens, thimerosal, benzyl alcohol or phenol.

91. The composition of any one of claims 48-70, wherein the composition is stable when stored at -80°C.

92. The composition of any one of claims 48-70, wherein the composition is stable when stored at -20°C.

93. The composition of any one of claims 48-70, wherein the composition is stable when stored at 4° C.

94. The composition of any one of claims 39-58, wherein the composition is stable when stored at room temperature.

95. A composition comprising isolated PSMA protein in a solution that promotes or preserves dimeric association of PSMA protein wherein the solution comprises:

(a) 5 to 20mM of sodium phosphate, sodium acetate or a combination thereof,

(b) 100 to 300mM sodium chloride or sodium sulfate, and

(c) 0.1 to 2mM of at least one metal ion.

96. The composition of claim 95, wherein the solution has a pH in the range of 4 to 8.

97. The composition of claim 96, wherein the solution has a pH in a range of 5 to 7.

98. The composition of claim 97, wherein the solution has a pH in a range of 6 to 6.5.

99. The composition of claim 96, wherein the composition further comprises an adjuvant.

100. The composition of claim 99, wherein the adjuvant is alum.

101. The composition of claim 95, wherein the metal ion is a zinc ion, calcium ion, magnesium ion, cobalt ion, manganese ion or a combination thereof.

102. A method of promoting or preserving dimeric association of PSMA protein in a solution comprising:

obtaining a solution of PSMA protein, and

adjusting the pH to be in the range of 4 to 8.

103. The method of claim 102, wherein the pH is adjusted to be in the range of 5 to 7.

104. The method of claim 103, wherein the pH is adjusted to be in the range of 5.5 to 7.

105. The method of claim 104, wherein the pH is adjusted to be 6.

106. A method of processing a PSMA protein comprising:

contacting the PSMA protein in a solution with a first agent that promotes or preserves dimeric association of PSMA protein in an amount effective to promote or preserve PSMA protein dimer formation.

107. The method of claim 106, wherein the amount effective to promote or preserve PSMA protein dimer formation is enough to promote or maintain at least 5%, 25%, 50%, 75% or 95% of the PSMA protein in PSMA dimer form.

108. The method of claim 106, wherein the first agent that promotes or preserves dimeric association of PSMA protein is a salt, metal ion or a pH adjusting agent.

109. The method of claim 108, wherein the cationic components of the salt is sodium, potassium, ammonium, magnesium, calcium, zinc or a combination thereof, and wherein the anionic component of the salt is chloride, sulfate, acetate or a combination thereof.

110. The method of claim 109, wherein the salt is sodium chloride, sodium sulfate, sodium acetate or ammonium sulfate.

111. The method of claim 109, wherein the salt is present at a concentration in the range of 50mM to 2M.

112. The method of claim 111, wherein the salt is present at a concentration in the range of 100mM to 300mM.

113. The method of claim 111, further comprising combining the PSMA protein solution with an adjuvant or diluent.

114. The method of claim 113, wherein the adjuvant or diluent is combined with the PSMA protein in an amount to dilute the salt concentration to 100mM to 300mM.

115. The method of claim 114, wherein the salt concentration is diluted to 150mM.

116. The method of claim 108, wherein the metal ion is a zinc ion, calcium ion, magnesium ion, cobalt ion, manganese ion or a combination thereof.

117. The method of claim 116, wherein the metal ion is a combination of zinc ion and calcium ion.

118. The method of claim 117, wherein the zinc ion and calcium ion are present at a concentration in the range of 0.1mM to 5mM.

119. The method of claim 117, wherein the zinc ion is present at a concentration that is lower than the concentration of the calcium ion.

120. The method of claim 119, wherein the zinc ion is present at a concentration of 0.1mM and the calcium ion is present at a concentration of 1mM.

121. The method of claim 116, wherein the metal ion is a magnesium ion.

122. The method of claims 121, wherein the magnesium ion is present at a concentration in the range of 0.1mM to 5mM.

123. The method of claim 122, wherein the magnesium ion is present at a concentration of 0.5mM.

124. The method of any one of claims 108-123, wherein the pH of the solution is adjusted to be in the range of 4 to 8.

125. The method of claim 124, wherein the pH of the solution is adjusted to be in the range of 5 to 7.

126. The method of claim 125, wherein the pH of the solution is adjusted to be in the range of 5.5 to 7.

127. The method of claim 126, wherein the pH of the solution is adjusted to be 6.

128. The method of claim 108, wherein the method further comprises contacting the PSMA protein with a second agent that promotes or preserves dimeric association of PSMA protein, and wherein the second agent is different than the first agent.

129. The method of claim 128, wherein the second agent that promotes or preserves dimeric association of PSMA protein is a metal ion, salt or pH adjusting agent.

130. The method of claim 129, wherein the metal ion is a zinc ion, calcium ion, magnesium ion, cobalt ion, manganese ion or a combination thereof.

131. The method of claim 129, wherein the cationic components of the salt is sodium, potassium, ammonium, magnesium, calcium, zinc or a combination thereof, and wherein the anionic component of the salt is chloride, sulfate, acetate or a combination thereof.

132. The composition of claim 131, wherein the salt is sodium chloride, sodium sulfate, sodium acetate or ammonium sulfate.

133. The method of any one of claims 128-132, wherein the pH of the solution is adjusted to be in the range of 4 to 8.

134. The method of claim 133, wherein the pH of the solution is adjusted to be in the range of 5 to 7.

135. The method of claim 134, wherein the pH of the solution is adjusted to be in the range of 5.5 to 7.

136. The method of claim 135, wherein the pH of the solution is adjusted to be 6.

137. A method of purifying a sample containing PSMA protein comprising:

subjecting the sample containing PSMA to chromatography in the presence of an agent that preserves or promotes the dimeric association of PSMA.

138. The method of claim 137, wherein the agent that promotes or preserves the dimeric association of PSMA is a metal ion, a salt or a solution with a pH in the range of 4 to 8 or a combination thereof.

139. The method of claim 138, wherein the metal ion is a zinc ion, calcium ion, magnesium ion, cobalt ion, manganese ion or a combination thereof.

140. The method of claim 139, wherein the metal ion is a combination of calcium ion and magnesium ion.

141. The method of claim 140, wherein the calcium ion and magnesium ion are each present at a concentration in the range of 0.1mM to 5mM.

142. The method of claim 141, wherein the calcium ion and magnesium ion are present at a concentration of 1mM and 0.5mM, respectively.

143. The method of claim 138, wherein the cationic component of the salt is sodium, potassium, ammonium, magnesium, calcium, zinc or a combination thereof, and wherein the anionic component of the salt is chloride, sulfate, acetate or a combination thereof.

144. The method of claim 143, wherein the salt is sodium chloride, sodium sulfate, sodium acetate or ammonium sulfate.

145. The method of claim 143, wherein the salt is present at a concentration in the range of 50mM to 2M.

146. The method of claim 145, wherein the salt is present at a concentration of 2M.

147. The method of claim 138, wherein the pH of the solution is in the range of 5 to 7.

148. The method of claim 147, wherein the pH of the solution is maintained in the range of 6 to 7.5.

149. A method of purifying a sample containing PSMA protein comprising:
applying the sample to a first column,
washing the first column with a first wash solution containing salt and metal ions,
and collecting the PSMA protein that elutes from the first column.

150. The method of claim 149, wherein the metal ions are zinc ions, calcium ions, magnesium ions, cobalt ions, manganese ions or a combination thereof.

151. The method of claim 150, wherein the metal ions are calcium and magnesium ions.

152. The method of claim 151, wherein the calcium ions and magnesium ions are present at a concentration in the range of 0.1mM to 5mM.

153. The method of claim 152, wherein the calcium ions and magnesium ions are present at a concentration of 1mM and 0.5mM, respectively.

154. The method of claim 152, wherein the cationic component of the salt is sodium, potassium, ammonium, magnesium, calcium, zinc or a combination thereof, and wherein the anionic component of the salt is chloride, sulfate acetate or a combination thereof.

155. The method of claim 154, wherein the salt is ammonium sulfate at a saturation of no more than 35% in the wash solution.

156. The method of claim 149, further comprising dialyzing or diafiltering the eluted PSMA protein with a first salt solution at a pH in the range of 6 to 7.5 to yield a dialyzed or diafiltrated solution containing PSMA protein.

157. The method of claim 156, wherein the first salt solution has a salt concentration of at least 5mM.

158. The method of claim 157, wherein the first salt solution is a 10mM sodium phosphate solution with a pH of 7.

159. The method of claim 149 or 156, further comprising:

loading the eluted PSMA protein, dialyzed or diafiltrated solution containing PSMA protein onto a second column,

washing the second column with a second salt solution,

and collecting the PSMA eluted by the second salt solution.

160. The method of claim 159,wherein the second salt solution has a salt concentration of 100mM to 2M.

161. The method of claim 160, wherein the second salt solution is 2M sodium chloride in 10mM sodium phosphate.

162. The method of claim 159 or 160, wherein the second salt solution has a pH in the range of 6 to 7.5.

163. The method of claim 159, further comprising

dialyzing or diafiltrating the PSMA eluted by the second salt solution with a metal ion solution,

applying the dialyzed or diafiltrated PSMA eluted by the second salt solution onto a third column,

washing the third column with a second wash solution containing salt and metal ions and collecting the PSMA eluted.

164. The method of claim 163, wherein the pH is maintained in the range of 6 to 7.5 through all of the purification steps.

165. The method of claim 163, further comprising separating the different forms of PSMA protein, wherein the different forms of PSMA protein are monomeric, dimeric or other multimeric forms of PSMA.

166. The method of claim 165, wherein the different forms of PSMA protein are separated by size exclusion chromatography.

167. A method of identifying an agent which promotes or preserves dimeric association of PSMA protein comprising:

determining the amount of a form of PSMA protein in a sample prior to exposure to a candidate agent,

exposing the sample to the candidate agent,

determining the amount of the form of PSMA protein in the sample after the exposure, and

comparing the amount of the form of PSMA protein in the sample prior to and after the exposure.

168. The method of claim 167, wherein the form of PSMA protein is monomer or dimer.

169. A method of treating a subject to elicit or enhance an immune response to cells in the subject expressing PSMA, comprising administering to the subject an effective amount of the composition of any one of claims 1-22, 43-71 and 95.

170. The method of claim 171, wherein the expressed PSMA is expressed on the cell surface.

171. The method of claim 169, wherein the method further comprises administering one or more booster doses of a composition comprising PSMA protein.

172. The method of claim 171, wherein the composition comprising PSMA protein is a composition of PSMA protein dimer.

173. The method of claim 171, wherein the booster dose composition further comprises an adjuvant.

174. The method of claim 171, wherein the booster dose composition is the composition of any one of claim 1-22, 43-71 and 95.

175. The method of claim 169, wherein the composition is administered by intravenous, intramuscular, subcutaneous, parenteral, spinal, intradermal or epidermal administration.

176. The method of claim 175, wherein the composition is administered by subcutaneous administration.

177. The method of claim 169, wherein the subject has cancer or has been treated for cancer.

178. The method of claim 177, wherein the cancer is a primary tumor or is metastatic cancer.

179. The method of claim 177, wherein the subject has prostate cancer.

180. A method of eliciting an immune response, comprising administering to a subject an effective amount of the composition of any one of claims 1-22, 43-71 and 95.

181. The method of claim 180, wherein the method further comprises administering one or more booster doses of a composition comprising PSMA protein.

182. The method of claim 181, wherein the composition comprising PSMA protein is a composition PSMA protein dimer.

183. The method of claim 181, wherein the booster dose composition further comprises an adjuvant.

184. The method of claim 181, wherein the booster dose composition is the composition of any one of claim 1-22, 43-71 and 95.

185. The method of claim 180, wherein the composition is administered by intravenous, intramuscular, subcutaneous, parenteral, spinal, intradermal or epidermal administration.

186. The method of claim 185, wherein the composition is administered by subcutaneous administration.

187. A kit which comprises the composition of any one of claims 1-22, 43-71 and 95 and instructions for use.

188. A kit which comprises the composition of any one of claim 22, 43-58, 39-49, 62-71 and 95, an adjuvant and instructions for mixing.

189. The kit of claim 188, wherein the adjuvant is alum.

190. A kit which comprises the composition of any one of claims 22, 43-58, 39-49, 62-71 and 95, a diluent and instructions for mixing.

191. The kit of any one of claims 187, 188, and 189, wherein the composition is provided in a vial or ampoule with a septum or a syringe.

192. The kit of any one of claims 187, 188, and 189, wherein the composition is in lyophilized form.

193. A pharmaceutical composition comprising the composition of any one of the compositions of claims 1-22, 43-71 and 95, and a pharmaceutically acceptable carrier.